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ABSTRACT

The availability and decreasing cost of hand held calculators has put pressure on educators to carefully consider the issues related to classroom utilization of these devices. This report focuses on information collected from over 400 participants at a series of National Science Foundation (NSF) funded activities in Chicago and St. Louis from 1978-1980. The participants included teachers, administrators, and parents. Common considerations of opinions on calculator use were: (1) programs should be based on sound policy, (2) programs should be based on well-defined procedure, and (3) programs should be implemented with teachers aware of the conditions under which calculators can be used. The report also contains sample responses to selected questions and issues, recommendations and statements concerning school utilization of calculators in grades K-6, suggestions regarding teacher training, and a materials list that survey participants felt was needed to implement and develop a calculator program in their schools. (MP)

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CALCULATORS IN THE ELEMENTARY SCHOOL A SURVEY OF HOW AND WHY

by

Leonard E. Etlinger and Earl J. Ogletree

The availability and decreasing cost of hand-held calculators has put pressure on educators to carefully consider the issues related to classroom utilization of these devices. During a series of National Science Foundation funded activities* in Chicago and St. Louis from 1978-1980, information was collected from over 400 participants with regards to how and why calculators should be used in the classroom. The objectives of the sessions were information spread and exchange, and facilitation of decision making: the participants included teachers, administrators, and parents.

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Opinions on the issues appeared to have a common consideration - implementation of hand-held calculator programs should be based on sound policy, well-defined procedure, and the caution due any innovative activities in education. The participants agreed that teachers need to be aware of how, when, with whom and under what conditions calculators can be used in the classroom. They felt that calculators should be used to reinforce basic facts, discover new concepts, explore number patterns, play instructional games, solve applicable problems and aid in a wide variety of math, science, and other subject matter learning. The only significant caveat developed by the participants was that:

> Calculators, like any educational innovations - whether ideas, materials, or devices - can be misused in the classroom. With calculators such misuse could be highly detrimental to the students' arithmetical development.

Findings

The participants first responded to a variety of questions in discussion, debate, or panel response formats and later formed working groups for the development of recommendations. Responses to selected questions and issues are presented next.

Can Children Learn Mathematics From Using Calculators In School?

Responses were almost entirely positive. Some typical responses were:

"Children can explore the ideas behind arithmetic, concepts of mathematics, numerical patterns, very large and very small numbers etc."

"Calculators can help with basic facts, multiplication and division, order of magnitude, intuitive concepts, and motivation in math."

"Children will learn more because it will be more interesting and fun."

"Kids can work with very large numbers and experiment with a variety of processes such as the square and root of numbers."

"Calculators can reinforce place value and number sequence. Approximation techniques can be developed."

Should Students Be Permitted To Use A Calculator All Of The Time In School?

"Probably Not! Children need to learn facts and basic skills without calculators."

"Math activities should be planned specifically for calculator or non-calculator usage. Attention should be given to the objectives of the activities."

"Children in junior and senior high school should probably be allowed to use calculators in most of their school work and tests."

"Very young children (kindergarten and first grade) should only use calculators in a few carefully designed instances."

Can Calculators Facilitate Creative Thinking In Students?

Most responses were affirmative. It was felt that calculators could enhance creativity:

"There are many fine examples of activities where children use their own creativity together with the calculator in numerical exploration."

"Pencil and paper calculation, particularly when not mastered properly, restricts creativity."

"Students are not limited to 'nice' or 'easy' numbers. Decimals, non-integral quotients, large numbers, and negative numbers can more easily be used in problems which are to be solved by calculators."

"Some students will attempt difficult problems which they would not think of trying without calculators."

"The gifted or advanced student will be challenged to explore sophisticated problems and concepts."

Should Children Use Calculators Before They Have Mastered The Basic Facts?

"Children must, eventually, be able to perform basic arithmetic without calculators."

"Calculators are motivational; this motivation may result in kids learning basic skills."

"Children should still learn basic skills without calculators, for the most part, and use calculators for other types of math learning. This other math learning could, in some instances, take place before basic skills are mastered."

"Possibly, older kids who have still not mastered basic skills can benefit by moving on in math and science with the aid of the calculator."

Should Calculators Be Used On Tests?

"Clearly not on tests of basic arithmetic skills."

"They probably should be allowed on most higher level tests."

"Tests should reflect real life needs. When appropriate, test rules should be changed to allow the use of calculators. National and regional tests, including standardized achievement tests, college admissions tests, and vocational aptitude tests should be reviewed in light of this changing technological aspect of society."

The project participants also generally agreed on the following points:

- Calculator activities must be carefully designed if genuine learning is to take place.
- Teacher training will be critical to proper school utilization of calculators.
- Many math activities particularly in the primary grades, must still be done without calculators.
- The greatest threat posed by calculators is that of misuse in the classroom. Poor teachers might use calculators as an excuse to avoid real teaching and learning.
- Continued exploration, research, curriculum development and policy formation is needed.

Recommendations

In a variety of working groups the project participants developed the following recommendations and statements concerning school utilization of calculators.

1. Primary Grades (K-3).

   B. Recommend usage of calculators to:

      1. Develop an understanding of the number system.

a) Provide additional practice with number sequencing and number recognition.

b) Develop place-value concepts.

c) Provide additional drill with basic facts.

d) Become more familiar with basic operations performed on numbers and number patterns.

e) To aid in introducing the concept of fractions.

f) To help the student become proficient in estimation.

g) Reinforce the base ten system (i.e. - metric, money.)

2. To concentrate on problem solving skills.

3. To promote success in arithmetic for slow learners.

4. To challenge the gifted student.

2. Middle Grades (4-6).

A. Reinforce and follow-up of ideas in grades (K-3) above.

B. Develop objectives for hand-held calculators in the curriculum at each grade level.

C. Each grade level and/or department should:

1. Integrate calculators into the curriculum by means of various topics such as:

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- Use to aid in the solution of real life problems.
- To check answers and formulae of algebraic problems.
- Introduction of programmable calculators to calculate commissions, mortgages, taxes and interest.

The following recommendations were made regarding teacher training:

Staff Development

Staff development program should be sufficient to meet the objectives established for each of the grade and/or department levels: Primary, Intermediate, Junior High, Senior High.

Suggestions include:

1. In-service workshops.
2. In-service credit or payment for courses.
3. Funds for resource people, professionals, video-taped lessons.
4. Released time to observe programs functioning.

Facilities (beyond those available through an individual school district) for providing in-service training should be:

a) University and college extension programs.

b) University and college short courses.

c) Facilities such as a learning center or teachers center. The teacher centers should provide facilities for staff development in the use of hand-held calculators.

5. Schools should train their own teachers to use calculators proficiently and have one "very proficient", or trouble-shooter teacher, to help out with teaching problems. Could be another professional, or a resource, to help with teaching problems.
6. Faculty must be supportive so there is no one undermining the program. School personnel (and parents) must be convinced.
7. Some guidelines should be established on use of calculators.

In addition to these suggestions additional research should be done to discover the "best" use of calculators in teaching and learning.

The participants in the workshop and survey were asked to list materials needed to implement and develop a calculator program in their school:

Materials

- Supply enough calculators for largest class in school. (It is probably important that this set consists of one standard model.)
- Booklet with suggested outline format including conceptual and skill activities appropriate to grade level.
- Individualized packet for student enrichment.
- Teacher packets that can be used in classroom situations.
- Identification of the use of the calculator in subject matters other than Math and Science; setting up packets to be used.
- Identification of the model of calculator used.
- Identification of the updated resource materials available.
- Learning Center activity books.